

Hybrid Vision Activities at NASA Johnson Space Center

Richard D. Juday

NASA Johnson Space Center

NASA's Johnson Space Center in Houston, Texas, is active in several aspects of hybrid image processing. (The term "hybrid image processing" refers to a system that combines digital and photonic processing.) Our major thrusts are autonomous space operations such as planetary landing, servicing, and rendezvous and docking. By processing images in non-Cartesian geometries to achieve shift invariance to canonical distortions, we use certain aspects of the human visual system for machine vision. That technology flow is bidirectional; we are investigating the possible utility of video-rate coordinate transformations for human low-vision patients. Man-in-the-loop teleoperations are also supported by the use of video-rate image-coordinate transformations, as we plan to use bandwidth compression tailored to the varying spatial acuity of the human operator.

Technological elements being developed in the program include upgraded spatial light modulators, real-time coordinate transformations in video imagery, synthetic filters that robustly allow estimation of object pose parameters, convolutionally blurred filters that have continuously selectable "invariance" to such image changes as magnification and rotation, and optimization of optical correlation done with spatial light modulators that have limited range and couple both phase and amplitude in their response.

Liaisons of varying degree of activity level and maturity exist between JSC and the Army (the Missile Command at the Redstone Arsenal—SLM and filter development, the Human Engineering Laboratory at the Aberdeen Proving Ground—video image compression for teleoperations), and the Air Force (RADC, Hanscom Field—exchanges relating to phase-mostly filter theory). JSC is promulgating a NASA participation in the DARPA/MICOM/RADC optical correlator development, to conform the results of that hardware development for use in space vision.